EVALUATION OF CHRONIC COUGH IN CHILDREN AGED 1 YEAR TO 12 YEARS

Dissertation Submitted For

M.D DEGREE (PEDIATRICS)

BRANCH VII

INSTITUTE OF CHILD HEALTH

AND

HOSPITAL FOR CHILDREN

MADRAS MEDICAL COLLEGE

THE TAMILNADU Dr. M.G.R. MEDICAL UNIVERSITY

CHENNAI

MARCH 2010

CERTIFICATE

This is to certify that the dissertation titled **"EVALUATION OF CHRONIC COUGH IN CHILDREN AGED 1 YEAR TO 12 YEARS"** submitted by **Dr.ANURADHA .G** to the Faculty of pediatrics, The Tamilnadu Dr. M.G.R. Medical university, Chennai in partial fulfillment of the requirement for the award of M.D. Degree (Pediatrics) is a bonafide research work carried out by him under our direct supervision and guidance.

Prof. Dr.P.RAMACHANDRAN,
M. D (Paed)., D.N.B (Paed).,
Unit Chief, M-4 Unit,
Institute of Child Health and Hospital for Children,
Madras Medical College, Chennai.

Addl. Prof.Dr.D.VIJAYASEKARAN,
M.D., D.C.H., Ph.D
Head of the Department,
Department of Pulmonology,
Institute of Child Health and Hospital for Children,
Madras Medical College, Chennai.

Prof. Dr.J.MOHANASUNDARAM,
M.D., Ph.D., DNB,
Dean,
Madras Medical College,
Chennai - 3.

Prof. Dr.SARADHA SURESH,
M.D., Ph.D.,F.R.C.P(Glascow)
Director & Superintendent,
Institute of Child Health and Hospital for Children,
Chennai - 8.

DECLARATION

I **Dr.ANURADHA .G** solemnly declare that the dissertation titled **"EVALUATION OF CHRONIC COUGH IN CHILDREN AGED 1 YEAR TO 12 YEARS"** has been prepared by me.

This is submitted to **The Tamilnadu Dr. M.G.R. Medical University**, Chennai in partial fulfillment of the rules and regulations for the M.D. Degree Examination in Pediatrics.

Dr. ANURADHA .G

Place : Chennai

Date :

ACKNOWLEDGEMENT

I express my sincere thanks to **Dr. J.MOHANASUNDARAM, M.D., DNB., PhD.,** The Dean, Madras Medical College and Research Institute for allowing me to do this dissertation and utilize the institutional facilities.

I would like to express my sincere gratitude to **Prof.Dr.SARADHA SURESH, M.D., Ph.D., F.R.C.P (Glas),** Director, Institute of Child Health and Hospital for Children for permitting me to undertake this study.

I am extremely thankful to **Prof. Dr. P. RAMACHANDRAN , M. D (Paed)., D.N.B (Paed).,** Professor of Pediatrics and our unit chief for his guidance, invaluable help, encouragement and support throughout the study.

I am extremely thankful to **Prof. Dr. D. VIJAYASEKARAN, M.D., D.C.H., Ph.D.,** Head of the Department of Pulmonology, for his guidance, invaluable help, encouragement and support throughout the study.

I would like to thank **Prof.Dr.S.SETHURAMAN, M.D., D.C.H.,** for his invaluable help and guidance.

I would like to thank the Assistant Professors of Pulmonology, **Dr.N.C.GOWRISHANKAR M.D(Paed)., D.N.B(Paed), Dr.KALPANA M.D., Dr.VIVEKANANDAN M.D., D.C.H.,** for their valuable guidance and assistance in doing this work.

I would like to thank the Assistant Professors of my unit, **Dr.R.RAJENDRAN M.D., D.C.H., Dr.MEKALAI SURESHKUMAR M.D., D.C.H., AND Dr. JAYAKUMAR M.D.** for their valuable guidance and assistance in doing this work.

I am extremely thankful to Assistant Professor **Dr.K.NEDUNCHELIAN** for his valuable suggestion and guidance in doing this study.

I extend my sincere thanks to **Dr.LUKERAVI CHELLAIYA,** Registrar for his valuable guidance in doing this work.

I express my sincere thanks to **Mrs.PARAMESHWARI,** Statistician, for helping me with the statistical analysis for this study.

I am indebted to all the children and their parents who had submitted themselves for this study.

Ref.No.Dir/EC/ICH/07

Institute of Child Health and Govt.
Hospital for Children, Chennai 8.
Dated: 9-06-08

The Institutional Review Board (Ethical Committee) of Institute of Child Health and Hospital for Children, Chennai was held on 13.5.2008 at 2.00 PM at the Deputy Superintendent's chamber.

MEMBERS PRESENT: Dr.R.Kulanthai Kasthuri,
Chairperson

Members:
1. Dr.K.Gita
2. Dr.P.Jeyachandran
3. Dr.T.Jothi
4. Dr.Paramanantham
5.Dr.D.Vijayasekaran
6.Prof.Girija Shyam Sundar
7.Mrs.Muthulakshmi, Advocate
8.Dr.P.Ramachandran

Title: **"Evaluation of Chronic Cough in Children < 12 years of age".**

The Institutional Review Board was satisfied with the revised format submitted by you. Hence the Institutional Review Board is pleased to approve the study.

9.6.08
Director and Superintendent

Director and Superintendent
Institute of Child Health and
Hospital for Childern
Egmore, Chennai - 600 008

To
Dr.G.Anuradha,
Post Graduate
Institute of Child Health and Hospital for
Children,
Chennai 600 008

CONTENTS

INTRODUCTION

Cough is a common symptom that brings a child to medical attention[1,2]. Cough may be viewed as a continuum of health through disease. It is a useful host defense mechanism. Cough gives protection to the tracheobronchial tree from potentially injurious substances and by removal of endogenous secretions and other materials, such as pus, necrotic tissue and foreign bodies[3]. Cough causes significant anxiety to parents[4,5] and use of inappropriate or unnecessary medications for a cough in children is associated with adverse events[6]. The aetiology and management approach for cough in children differs greatly than adults, so the empirical approach commonly used in adults is unsuitable for children. Clinical evaluation of cough in children should also include an assessment of environmental factors, particularly tobacco smoke. An acute cough[7] (cough less than 4 weeks duration) is usually due to a viral infection or an upper respiratory infection. But a chronic cough[7] (4 weeks or more) needs to be evaluated for the specific cause, as significant morbidity is associated with it and a serious illness needs to be ruled out. A single cause can be found in up to 82% of all cases of chronic cough[8].

RESPIRATORY SYSTEM

Respiratory system begins in the external nares and ends in alveoli. The right lung is divided into three lobes by two interlobar fissures – the upper, middle and lower. The left lung is divided into two lobes by one interlobar fissure- the upper and lower. The trachea divides into the right and left bronchi. The intrapulmonary bronchi divide and subdivide throughout the entire organ, the smallest subdivisions constituting the terminal bronchioles.

Each bronchiole divides into two or more respiratory bronchioles**,** with scattered alveoli, and each of these again divides into several alveolar ducts**,** with a greater number of alveoli connected with them. Each alveolar duct is connected with a variable number of irregularly spherical spaces, the atria**.** With each atrium a variable number (2–5) of alveolar sacs are connected, which bear on all parts of their circumference alveoli or air sacs. The alveoli are lined by a delicate layer of simple squamous epithelium.

The main function of the respiratory system is to supply sufficient oxygen to meet the metabolic needs and remove carbondioxide.

A variety of processes including ventilation, perfusion, and diffusion are involved in tissue oxygenation and carbon dioxide removal.

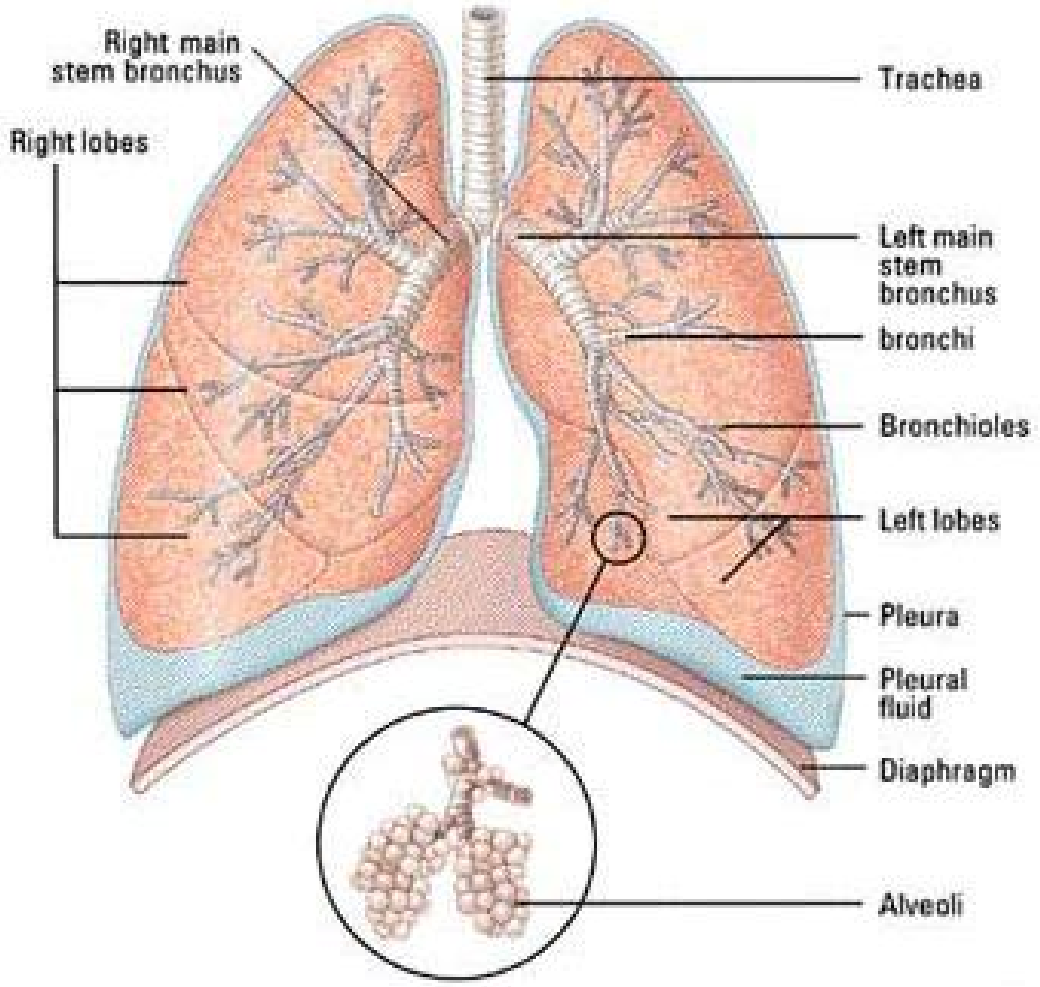


Fig.1 : RESPIRATORY SYSTEM

NEURAL PATHWAY OF COUGH REFLEX

Cough is an important reflex defense mechanism for clearing the airways of inhaled noxious stimuli.

RECEPTORS

The reflex begins with stimulation of the cough receptors by viruses, aeroallergens and chemicals.

There are two distinct types of afferent fibres, namely: the rapidly adapting irritant receptors (RARs) and the capsaicin-sensitive unmyelinated bronchial C-fibres[9]. The former type of fibres is sensitive to mechanical and/or chemical stimuli[9].

They are present throughout the respiratory tract down to the respiratory bronchioles, especially the posterior wall of the trachea, carina and branching points of large airways. They are also present in the external auditory canals and tympanic membrane, pleura and pericardium, where they tend to respond to only mechanical stimuli[10].

The bronchial C-fibres are neuropeptide-containing nerve fibres that are sensitive to chemical stimulation rather than mechanical stimulation[11]. Stimulation of these fibres causes bronchial smooth muscle contraction, vasodilatation, plasma extravasation and mucus secretion[12]. However, the exact role of C-fibres in the human cough reflex is still unclear[11].

The afferent impulses, through the vagus, glossopharyngeal and trigeminal nerves, are relayed to the nucleus of the tractus solitarius in the brainstem before they are transmitted to the cough centres in the medulla oblongata where they are integrated. The efferent output is located in the nucleus retroambigualis and nucleus ambiguus in the brainstem, and this travels down the phrenic and other spinal motor nerves to the respiratory musculature[10]. There are also vagal efferents innervating the bronchial smooth muscle, thus causing constriction[13].

Animal studies suggest that the production of cough is a gated process. The exact location and identity of the responsible neurons in the brainstem remain unclear, but this tracheobronchial gate regulates the production, magnitude and duration of the cough[14]. The vagal afferents may also directly stimulate the airway submucosal glands, thereby causing mucus production,which serves as another protective mechanism against noxious aeroallergens[15]. The neural pathway may undergo changes, termed plasticity of cough reflex, resulting in excessive and inappropriate responses. This may be due to an increase in receptor density or an upregulation of the receptor sensitivity, either at the periphery or central level[16].

PHYSIOLOGY OF COUGH

Cough is a rapid and ballistic movement. A typical cough starts with a deep inspiration to at least 50% of the vital capacity. This is followed by the compression phase, where the glottis closes for about 0.2 second and there is contraction of the respiratory musculature. The glottis then opens suddenly. This unleashes the high intrapleural pressure that develops during the glottic closure,creating a high expiratory flow rate and narrowing the central airways, which can be as high as 12 L/sec following the start of the expiratory phase. Finally, the relaxation phase completes the act when the respiratory musculature relaxes with a reversal of the intrathoracic pressure[10,14]. Normal function of the mucociliary apparatus is critical in maintaining an effective cough, as it brings secretions from the periphery to the proximal airways where they can be cleared by coughing.

TYPE OF COUGH [17, 18]

Duration of cough

- Acute cough: cough duration of < 2 weeks;
- Protracted acute cough: cough duration between 2 and 4 weeks; and
- Chronic cough: cough duration of > 4 weeks;

Underlying disease or process

- Expected cough
- Specific cough and
- Nonspecific cough;

Cough quality

- Classically recognised cough;
- Wet/moist or productive cough and dry cough
- Protracted bronchitis.

Certain history like the type of cough, its positional and diurnal variation gives clues to the etiological diagnosis of chronic cough.

Table 1

Pointers to the etiology of Chronic cough[17,18]

Barking or brassy cough	Croup, tracheomalacia, habit cough
Honking	Psychogenic
Paroxysmal (with or without inspiratory “whoop”)	Pertussis and parapertussis
Staccato	Chlamydia in infants
Cough productive of casts	Plastic bronchitis/asthma
Chronic wet cough in mornings only	Suppurative lung disease

Chronic cough needs to be evaluated for the underlying disease in a systematic manner regarding the nature, timing, and onset of cough, site of pathology, associated clinical features, and response to previous medications, seriousness of problem, the differential diagnosis and investigation.

Table 2

Causes of chronic cough [17,18]

Isolated cough : otherwise healthy child	**Isolated cough:** significant underlying cause
• Recurrent viral bronchitis • Post infectious cough • Pertussis like illness • Cough variant asthma • Postnasal drip	Chronic suppurative lung disease • cystic fibrosis • immune deficiencies • recurrent pulmonary aspiration • retained inhaled foreign body
Psychogenic cough • Habit(‘tic’ like) • Bizarre honking cough	Airways lesion • compression, eg. TB lymphnode • malacia, e.g. tracheomalacia.
Gastro- oesophageal reflux disease	

REVIEW OF LITERATURE

Suna Asilsoy, *et al* in 2008 in Turkey attempted to research the reasons for chronic cough by an evaluation method using the guideline that was suggested for children by American College of Chest Physicians (ACCP) in 2006. They studied 108 children between 6 and 14 years of age having cough that lasted more than 4 weeks. The patients were reevaluated on the 2nd - 4th weeks, and until either the cough terminated or resolved. 25% of the cases were diagnosed asthma - asthma like, 23.4% protracted bronchitis, 20.3% upper airway cough syndrome and 4.6% gastroesophageal reflux disease. Asthma and asthma-like, protracted bronchitis and upper airway cough syndrome were detected in order of frequency as the reason for chronic cough in children. They have concluded that the 2006 ACCP guideline for the management of chronic cough in children is effective and can be successfully utilized in a non-affluent study setting[(19)].

Dani, *et al* in Nagpur, Maharashtra in 2001 have prospectively studied about 94 immunocompetent children who presented with cough of more than 3 weeks at the time of admission. They have done a detailed history taking, physical examination, sequential incorporation of routine investigations and special investigations when needed.

Their results showed bronchial asthma (23.4%) and cough variant asthma (13.8%) was found to be the commonest cause of chronic cough followed by tuberculosis (22.3%). Other causes included sinusitis (9.5%), pulmonary eosinophilia (9.5%), bronchiectasis (5.3%), bronchopneumonia (5.3%), pertussis (4.2%), gastro-oesophageal reflux (2.2%), foreign body aspiration (2.2%) and undiagnosed (2.2%)[20].

Daljit Singh, *et al* P Ludhiana, Punjab, in their prospective study of 2275 children in the age group of 1 to 15 years were screened by house to house survey for chronic/recurrent cough using defined criteria. A detailed work up of selected cases was carried out. Underlying etiology was determined using clinical and laboratory parameters. Five hundred children in the study population formed the control group. Variables associated with chronic/recurrent cough were analyzed in cases and controls. 24 children were diagnosed with chronic/recurrent cough showing a prevalence rate of 1.06%. The most common cause was bronchial asthma (66.7%) followed by postnasal drip syndrome (25%). Family history of allergy/asthma was noted in 11 (45.8%) children as compared to 52 (10.4%) in the control group ($p < 0.01$). Family history of smoking was recorded in 16.7% of cases in contrast to

6.4% in controls (p=0.05). There was no significant association with overcrowding, pets and kind of cooking fuel used[21].

Shally awasthi, *et al* in 1999 in Lucknow, school based, prospective survey using self/parental reporting of occurence of asthma or wheeze on pre-designed questionnaire to assess the prevalence of asthma and wheeze and factors associated with it in children aged 6-7 years and 13 to 14 years. Prevalence of asthma and wheeze reported were 2.3% and 6.2%, respectively, in age group 6-7 years and 3.3% and 7.8%, respectively, in age group 13-14 years. On the basis of adjusted odds ratio, risk factors for wheeze /asthma were education of mother, antibiotic use in the first year of life, eating pasta or fast-food or meat once or more/week and exercise once or more/week while the protective factors were intake of vegetables once or more and fruits thrice or more per week. In univariate analysis, breastfeeding was also found to be protective[22].

Rakesh Lodha, *et al* in 2008 In his study on cough and persistent pneumonia included nineteen children (16 boys) with persistent pneumonia and studied over a period of 5 years. Based on the clinical features and the results of the investigations, underlying illness could be identified in 16 (84.2%) children. The most frequent underlying causes

for persistent pneumonia in children were asthma (26.3%) and post-tubercular bronchiectasis (26.3%)[23].

Anna B Chang, *et al* in their article published in CHEST journal in 2006 have given the guidelines for evaluating chronic cough in children[7].

Thomson, *et al* in 2002 from Northern Australia have studied prospectively the children referred for persistent cough. Of the 49 children, 61.2% were diagnosed with asthma at referral, with similar referral rates from general practitioners and pediatricians. Children with isolated cough were just as likely to have been diagnosed with asthma as children with cough and wheeze. Medication use (asthma, gastro-esophageal reflux and antibiotics) prior to referral was high, asthma medications were most common, and of these 12.9% had significant steroid side effects. The most common abnormality found (46.9%) was a bronchoscopically defined airway lesion, and in 56.5% of these children, another diagnosis (aspiration, achalasia, gastro-oesophageal reflux) existed. None of the children had a sole final diagnosis of asthma and pre-referral medications were weaned in all children. They concluded saying, over diagnosis of asthma and the overuse of asthma treatments with significant side effects is common in children with

persistent cough referred to a tertiary respiratory clinic. Children with persistent cough deserve careful evaluation to minimize the use of unnecessary medications and, if medications are used, assessment of response to treatment is important[24] .

H M Lewis, *et al* in 1999, have investigated the background and aetiology of chronic cough by comparing 60 children under 6 years with simple cough, 60 children with asthma, and 60 controls. Both cough and asthma were more common in boys and associated with a history of eczema, chest deformity, and skin reactivity to inhaled allergens, but these findings were more prevalent in asthma than cough. House dust mite sensitivity was found in 34 (57%) children with cough, 45 (75%) with asthma, and six (10%) controls[25].

A O Faniron, *et al* in Australia, in his study in 1999, to determine if children in the community with persistent cough can be considered to have asthma, a validated questionnaire was given to the parents of 1245 randomly selected children aged 6-12 years. Atopy was measured with skin prick tests. Children with persistent cough had less morbidity and less atopy compared with children with wheeze. Although the syndrome commonly referred to as "cough variant asthma" could not be shown in this study, a significant number of children with persistent

cough had been diagnosed as having asthma and were treated with asthma medications including inhaled corticosteroids. Studies are urgently needed to determine the appropriate treatment for children with persistent cough[26].

T K Ninan, *et al* in 1995 in Aberdeen, carried out a cross sectional epidemiological study to investigate the validity of persistent nocturnal cough (PNC) as an independent marker of childhood asthma. A screening questionnaire on respiratory symptoms was applied to 4003 children attending primary schools in Aberdeen, after which 799 symptomatic children and a random selection of 229 asymptomatic children were invited to attend for a diagnostic interview. Six hundred and seven (359 boys and 248 girls) symptomatic children and 135 asymptomatic children (57 boys and 78 girls) were selected from the screening questionnaires. Of 607 children with respiratory symptoms when interviewed, 27 (nine boys and 18 girls) had isolated persistent nocturnal cough, and 97 (51 boys and 46 girls) had multiple symptoms (poly-symptomatic asthma). Using a stepwise discriminant analysis procedure, in 18 (67%) children with PNC predicted membership was in the asymptomatic group and only nine (33%) children with PNC were grouped into the polysymptomatic asthma category. It is concluded that

the clinical features of children with PNC resembled those of the asymptomatic population more closely than those of the polysymptomatic asthmatic population. In this age group PNC, in the absence of wheeze, shortness of breath or tightness in the chest, is likely to be a manifestation of atypical or hidden asthma in only a minority of cases[27].

STUDY JUSTIFICATION

Most coughs of acute onset are self limiting. Chronic cough gives more anxeity to parents and the physicians. Chronic cough is unlikely to occur in the absence of disease or abnormal physiological functioning[28]. Chronic cough may have a variety of underlying disorders ranging from a minor condition to life threatening ones. The factors responsible for the prevalence and age distribution of chronic cough vary from place to place and this study was planned to determine the age distribution and the common causes of chronic cough in children in our hospital setup.

AIM OF THE STUDY

To study the clinical and diagnostic spectrum of chronic cough in children aged 1 to 12 years.

SUBJECTS AND METHODS

STUDY DESIGN

Descriptive study.

STUDY PERIOD

October 2007 to October 2009.

STUDY PLACE

Department of Pulmonology, Institute of Child Health and Hospital for Children, Chennai.

SAMPLE SIZE

64.

SAMPLING TECHNIQUE

None.

STUDY POPULATION

Children in the age group of 1 to 12 years, presenting with chronic cough (cough for 4 weeks or more[7, 28]), who came to the outpatient department during the study period were included.

INCLUSION CRITERIA

Case definition: All children with chronic cough attending the outpatient department and/or getting admitted with chronic cough during the study period are included in the study.

EXCLUSION CRITERIA

Congenital heart diseases

Cerebral palsy and neurological abnormalities.

MANOEUVRE

Children in the age group of 1 to 12 years presenting with cough of 4 or more weeks in the out-patient department were admitted and a detailed history was elicited. Age, sex distribution, clinical features associated with chronic cough like breathlessness, fever, nasal discharge, postnasal drip, regurgitation of feeds, any other focus of infection like ear discharge, family history of asthma, atopy, smoking, and past history of tuberculosis, wheezing and its relief with bronchodilators, history of overcrowding were recorded. Thorough clinical examination including a general examination and systems examination were done to check for other focus of infection and to rule

out congenital heart disease. Chest examination was done to find out crepitations and wheeze. Following investigations were done in all of them. Routine investigations like complete blood count with differential count, Mantoux test, sputum examination, and X ray chest were done. Other investigations done were bronchoscopy, HIV-ELISA,CT scan chest and paranasal sinuses, barium swallow, endoscopy and biopsy whenever needed. The causes of chronic cough were made out as per the defined diagnostic criteria.

DIAGNOSTIC CRITERIA

Bronchial asthma

The most widely accepted classification of asthma is that recommended by the National Heart, Lung, and Blood Institute's (NHLBI) National Asthma Education and Prevention Program (NAEPP) Expert Panel Report 2 "Guidelines for the Diagnosis and Management of Asthma"(1995). These guidelines place major emphasis on diagnosis (including classification of asthma) and management (including a stepwise approach to asthma treatment. The Global Initiative for Asthma (GINA) guidelines (1998) were the combined effort of NHLBI and the World Health Organization (WHO). Although these

recommendations are essentially similar to the NAEPP guidelines, Asthma severity is divided into the same classes in the NAEPP, GINA, and AAAAI guidelines. Classification is based on history of asthma symptoms and lung function before therapy begins and is described as mild intermittent, mild persistent, moderate persistent and severe persistent. We have used the above guidelines in our study. Bronchial asthma is defined by recurrent episodes of non- productive cough, breathlessness and wheezing, having family history in some cases, with response to bronchodilators alone or with corticosteroids.

Table 3

Comparison of asthma classification by GINA versus NAEPP
(Derived from the GINA and NAEPP Guidelines[1,3])

STEP	Symptoms / Day		Symptoms / Night		PEF or FEV, PEF Variability	
	GINA	NAEPP	GINA	NAEPP	GINA	NAEPP
Step 1 **Mild Intermittent**	<1 time a week	≤ 2 days a week	≤ 2 times a month	≤ 2 nights a month	≥ 80% ——— <20%	≥ 80% ——— <20%
Step 2 **Mild Persistent**	>1 time a week	> 2 days a week but ≤ 1x/day	> 2 times a month	> 2 nights a month	≥ 80% ——— 20-30%	≥ 80% ——— 20-30%
Step 3 **Moderate Persistent**	Daily-Attacks affect activity	Daily-Attacks affect activity	> 1 time a week	> 1 night a week	60-80% ——— >30%	>60-<80% ——— >30%
Severe Persistent	Continuous - Limited Physical activity	Continuous - Limited Physical activity	Frequent	Frequent	≤ 60% ——— >30%	≤ 60% ——— >30%

PEF - Peak Expiratory Flowrate FEV - Forced Expiratory Volume

Diagnosis and classification of asthma is done as per the above guidelines.

The child needs to be assessed for the diagnosis even before the start of the treatment. Emergencies in asthma do not correlate always with the severity of asthma.

Pneumonia

The patients present with fever, tachypnea (respiratory rate/min >60 in <2 months of age, >50 in 2-12 months of age, >40 in 12-60 months of age), breathlessness, cough. Clinical examination revealed respiratory distress, crepitations in chest or bronchial breathing. X ray will give the clue of the diagnosis.

Bronchiectasis

Cough of prolonged duration with copious sputum production. Chest examination revealed coarse leathery crackles. X ray chest is diagnostic. High resolution CT chest remain the gold standard of diagnosis.

Tuberculosis

Cough with low grade fever of long duration, loss of appetite and weight, lymphadenopathy or failure to thrive or protein energy malnutrition with or without family history of tuberculosis. X ray chest

and Mantoux test gave clue to diagnosis. FNAC of lymph node was contributory in some cases.

Gastroesophageal reflux

GER was suspected when there was history of upper abdominal pain, recurrent episodes of vomiting, coughing, wheezing or breathlessness. Barium swallow study demonstrated reflux of barium. Endoscopy revealed a lax lower oesophageal sphincter.

Sinusitis

Patients present with a history of cough, headache, frequent clearing of throat and sinus tenderness. Physical examination revealed mucoid or mucopurulent secretions and / or cobblestone appearance of the mucosa. X ray paranasal and other sinuses helped in the diagnosis- opacity or asymmetry of sinuses.

Foreign body aspiration

Patients present with a history of aspiration of foreign body, sudden onset gagging, choking or coughing. They had wheeze, respiratory distress or both. X ray chest was suggestive of collapse, emphysema, or reveal a radio opaque substance.

Post Nasal Drip Syndrome (PNDS)

PNDS was considered when (*i*) patients described the sensation of having something drip down into their throats, frequent nasal discharge, and/or the need to frequently clear their throats, or (*ii*) physical examination of the nasopharynx or the oropharynx revealed mucoid or mucopurulent secretions and/or a cobblestone appearance of the mucosa [29,30,31].

Criteria for overcrowding:

Children above 10 years are considered 1person unit and children 1 to 10 years are considered as ½ person unit.

Table 4

Overcrowding

Number of Rooms	Person Units
1 Room	>2 Person Units
2 Rooms	>3 Person Units
3 Rooms	>5 Person Units
4 Rooms	>71/2 Person Units
5 Rooms	>10 Person Units

STATISTICAL ANALYSIS

The mean and standard deviation of all quantitative parameters were calculated.

Percent occurrence rate (Frequency) of different symptoms and diagnosis of the sample subjects was calculated.

Pearson Chi square test was applied to quantify extent of intergroup differences. (p value < 0.05 was considered statistically significant).

Results were given as tabulations or pictorial representations.

OBSERVATION AND RESULTS

Sample Size

Total number of children who presented with chronic cough recruited into the study was 64.

Mean age of chronic cough

Majority of children [24(37.5%)] presented with chronic cough belonged to 4 to 6 years age group. The mean age of presentation was 5.35+ 3.07 years

Sex disparity

In the present study, 43(67.2%) cases were boys and 21(32.8%) were girls.

Table 5

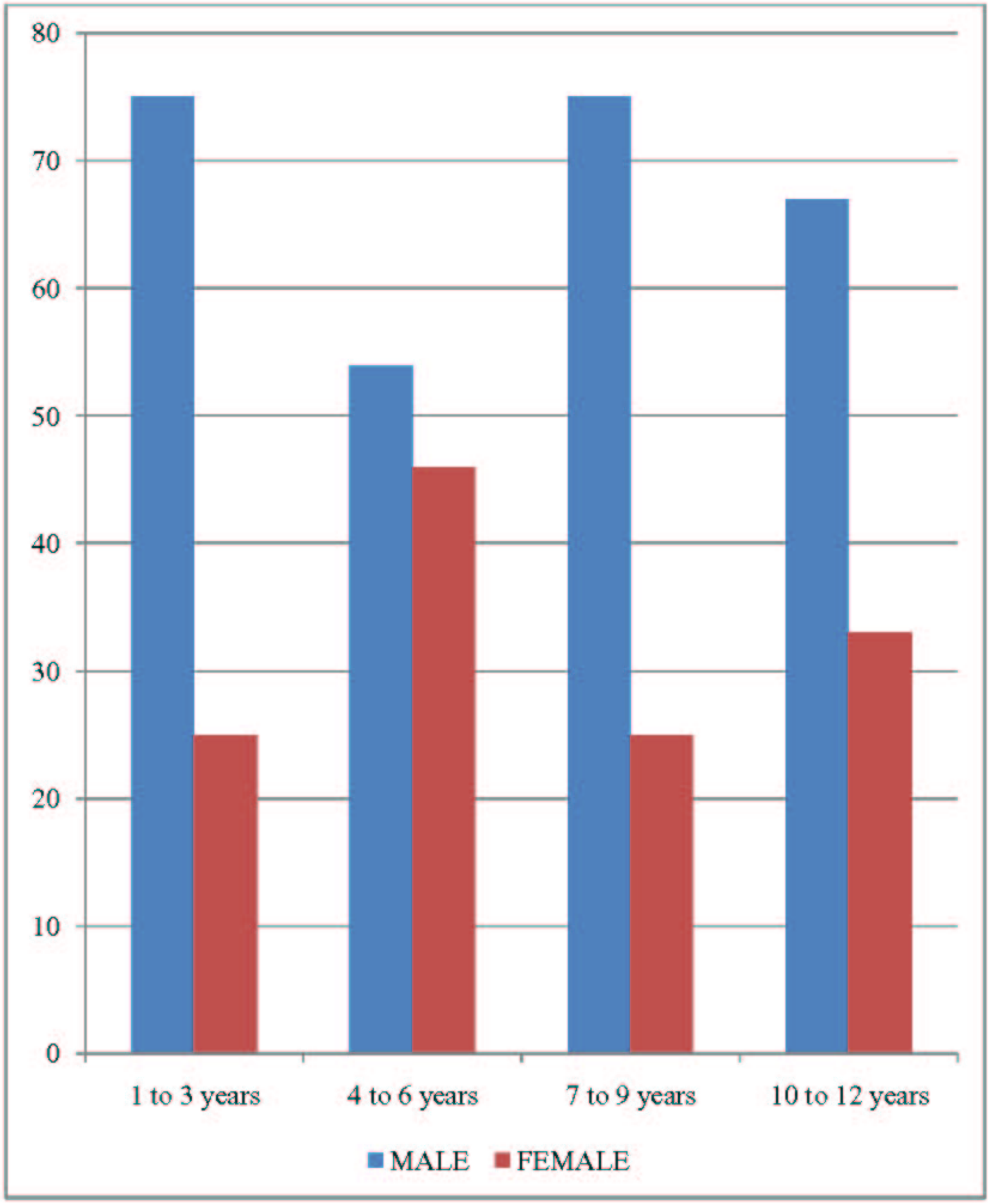
Age and Sex distribution of children presenting with Chronic Cough

AGE	MALE n (%)	FEMALE n (%)	TOTAL n (%)
1-3 years	15 (75%)	5 (25%)	20 (31.25%)
4-6 years	13 (54%)	11 (46%)	24 (37.5%)
7-9 years	9 (75%)	3 (25%)	12 (18.75%)
10-12 years	6 (75%)	3.1 (25%)	8 (12.5%)
TOTAL	43 (67.2%)	21 (32.8%)	64 (100%)

The proportion of boys (67.2%) was more than girls (32.8%) in children who presented with chronic cough. Boys outnumbered girls in all the age groups.

CHART 1

AGE AND SEX DISTRIBUTION OF STUDY POPULATION



COUGH CHARACTERS

Duration of cough

The duration varied from 1 month to 5 months in study population. The mean duration and standard deviation of cough was 63.75+ 41.91days.

Type of cough

Cough was not of any specific type in any of the cases.

Expectoration

Cases of chronic cough that presented with sputum production were 4(6.25%) out of 64 cases. Hemoptysis was present in 1(1.56%) case with chronic cough.

Diurnal variation

The cough occurred most frequently during the day than at night. Day time cough frequency was documented in 50 (78.5%) and night time cough in 14(21.5%).

Seasonal and postural variation

Seasonal variation of cough was noted in 6 (9.37%) of the cases of chronic cough.

There was no postural variation of cough or expectoration in any of the cases.

Breathlessness

Number of cases with chronic cough those presented with breathlessness was 47(73.4%).

Fever

53(82.8%) cases had an associated symptom of fever.

Triggers

History of triggers for symptoms like cough, wheeze and breathlessness was noted in 17(26.56%) of the cases.

Regurgitation

Regurgitation was noted in 4 (6.25%) cases of chronic cough. Out of whom, 1case had hemetemesis.

Contact history of tuberculosis

Contact history of TB was present in 10(15.65%) cases of chronic cough.

Past history

Past history of treatment with anti tuberculosis drug was present in 3 (4.68%) chronic cough cases. Previous history of wheeze and relief with bronchodilators was documented in 17 (26.56%) of the cases with chronic cough. Past history of pneumonia was noted in 2 (3.12%) cases.

Family history

Family history of asthma was present in 8 (12.5%) cases, atopy in 10(15.6%) cases.

Smoking

History of passive smoking was present in 7 (10.93%) cases.

Overcrowding

Overcrowding was noted in 6 (9.5%) cases as per the criteria defined above.

Immunization

Among cases of chronic cough, 86.9% were fully immunized as per National Immunization Schedule, 11.5% were partially immunized and 1.6% was not given any of the vaccines. None of the cases were given Pneumococcal or Hemophilus influenza B vaccine. BCG scar was absent in 12 (19%) cases.

Weight

Weight less than 80% is considered undernourished. Number of undernourished children in our study was 37 (57.8%) out of 64 cases of chronic cough.

Lymphadenopathy

Cervical lymphadenopathy was noted in 20(31.25%) cases.

Clubbing

Clubbing was seen in 6(9.3%) cases of chronic cough.

Chest examination

Rhonchi was noted in 22(34.34%) cases of chronic cough.

Crepitations were observed in 52(81.25%) of chronic cough.

Diagnosis

The causes of chronic cough were found to be bronchial asthma in 21.9%(n=14), tuberculosis in 20.3%(n=13), bronchiectasis in 12.5%(n=8), pneumonia in 17.2%(n=11), foreign body in 6.3%(n=4), gastro esophageal reflux disease in 3.2%(n=2), airway anomalies in 4.7%(n=3), maxillary sinusitis in 1.6%(n=1), bronchiolitis obliterans in1.6%(n=1), interstitial lung disease in 1.6%(n=1), laryngeal papilloma in 1.6%(n=1), hypoplasia lung in 1.6%(n=1), post nasal drip syndrome in 1.6%(n=1), paraganglioma in 1.6%(n=1), erosive gastritis in 1.6%(n=1), undiagnosed in 1.6%(n=1).

Table 6

Etiological Diagnosis of Chronic Cough In Children

Diagnosis	Number	Percentage
Asthma	14	21.9%
Tuberculosis	13	20.3%
Pneumonia	11	17.2%
Bronchiectasis	8	12.5%
Foreign Body	4	6.3%
Airway Anomaly	3	4.7%
GERD	2	3.2%
Bronchiolitis Obliterans	1	1.6%
Hypoplasia Lung	1	1.6%
Interstitial Lung Disease	1	1.6%
Paraganglioma	1	1.6%
Postnasal Drip Syndrome	1	1.6%
Sinusitis	1	1.6%
Erosive Gastritis	1	1.6%
Laryngeal Papilloma	1	1.6%
Undiagnosed	1	1.6%
Total	64	100%

The four leading causes of chronic cough in our study were found to be Bronchial asthma, Tuberculosis, Pneumonia and Bronchiectasis. Asthma was typed as mild persistent in 12 cases and moderate persistent in 2 cases. Persistent pneumonia was diagnosed in 2 of the cases of pneumonia, recurrent pneumonia in 2 cases pneumonia and eosinophilic pneumonia in 1 case. Among the tuberculosis patients, latent TB was diagnosed in 1case, miliary TB in 1case, endobronchial TB in 9 cases.

The number of cases with seasonal variation of cough in our study was 6 out of 64 and all the cases had the final diagnosis as asthma with the significant p value (0.000).

ASSOCIATION OF FEVER WITH CHRONIC COUGH

Fever was the presenting symptom with chronic cough in all the cases diagnosed as pneumonia when compared to 21.3% of asthma cases, 76.9% of TB cases, and 77.5% of bronchiectasis cases. The difference observed is statistically significant, p value 0.001.

Table 7

Fever in Chronic Cough

DIAGNOSIS	FEVER n (%)
ASTHMA	3(21.3%)
TUBERCULOSIS	10(76.9%)
PNEUMONIA	11(100%)
BRONCHIECTASIS	6(77.5%)

Table 8

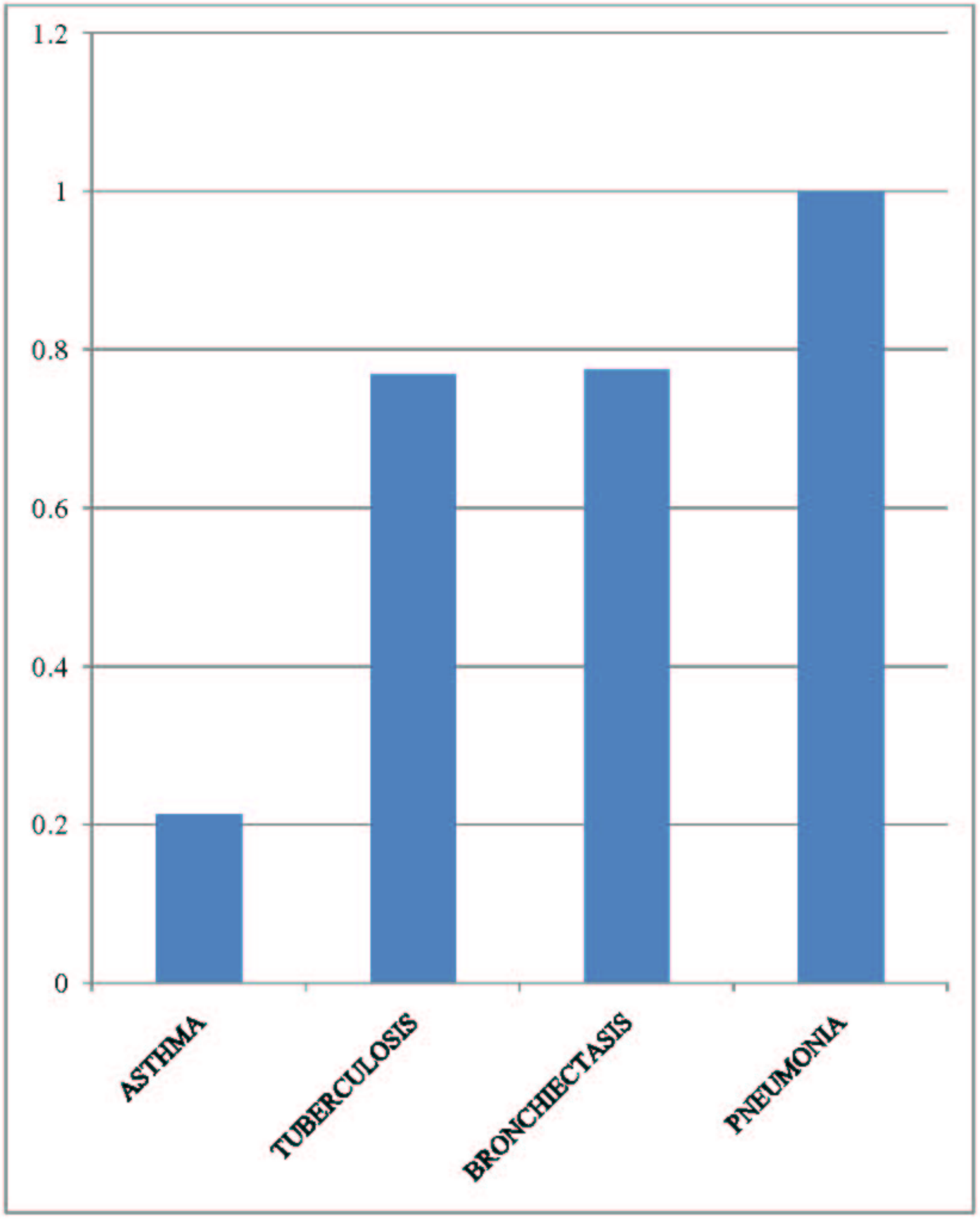
Pearson Chi Square Analysis

Fever	Pneumonia	No Pneumonia	Total
Present	11	25	36
Absent	0	28	28
Total	11	53	64

P value = 0.001

CHART 2

FEVER IN CHRONIC COUGH



ASSOCIATION OF BREATHLESSNESS AND CHRONIC COUGH

Of the children who presented as chronic cough, in whom diagnosis was

TB, 12 (92.3%) cases presented with breathlessness in our study. In asthma, 7(50%) cases presented with breathlessness. Hence, in our study it was found that, >90% of tuberculosis cases presented with breathlessness at the time of presentation.

Table 9

Children with Breathlessness in Chronic Cough

DIAGNOSIS	BREATHLESSNESS
ASTHMA	7 (50%)
TUBERCULOSIS	12 (92.3%)
PNEUMONIA	8 (72.7%)
BRONCHIECTASIS	6 (75%)

EXPECTORATION

All the cases with sputum production were diagnosed finally as bronchiectasis.

REGURGITATION AND CHRONIC COUGH

Regurgitation was noted in 4 (6.25%) of the cases of chronic cough. Of whom, 2 cases were diagnosed as gastro esophageal reflux disease, 1 case as erosive gastritis and other one as tracheomalacia. Regurgitation is a significant history for diagnosis of gastro esophageal reflux disease (p value 0.000).

Table 10

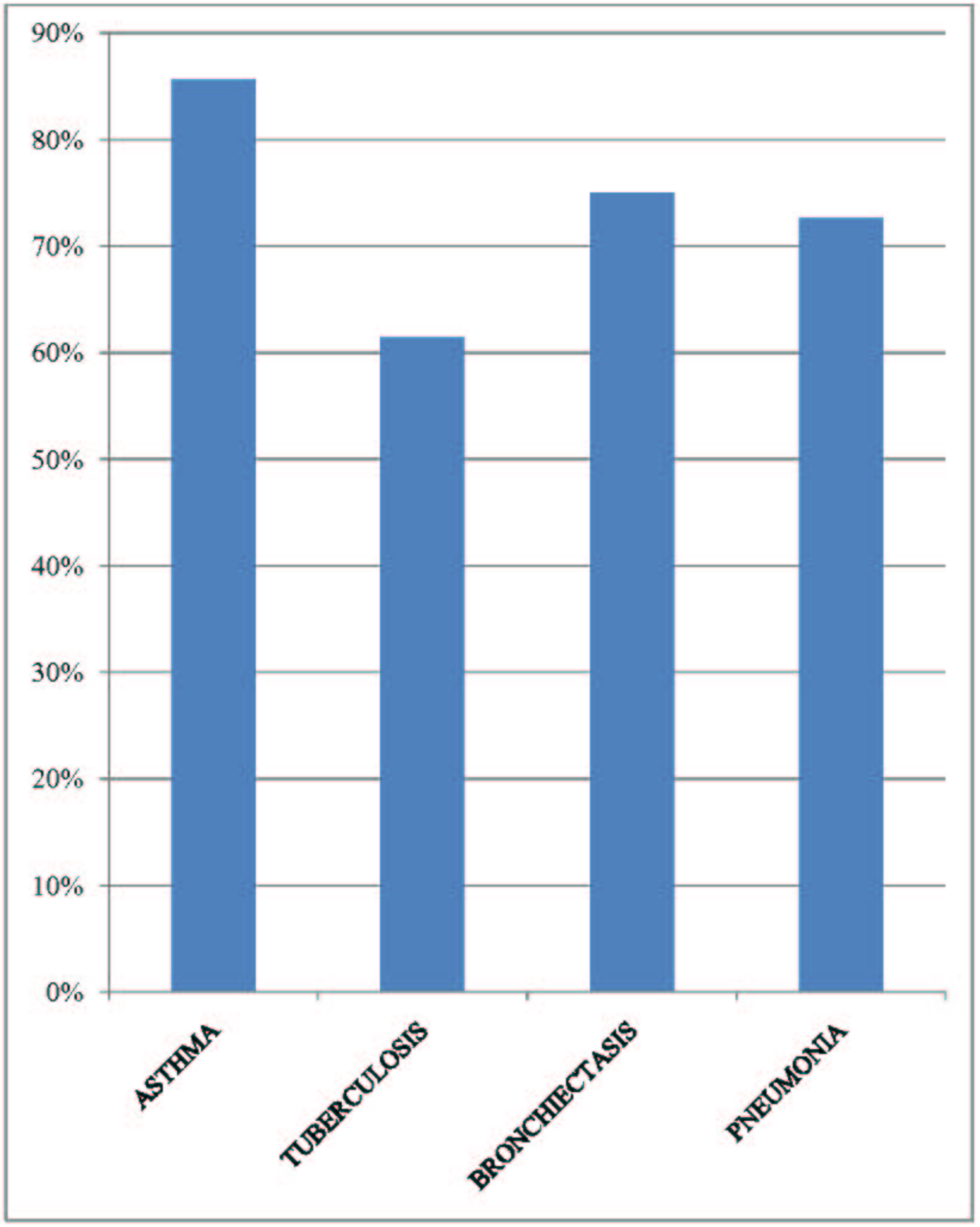
Pearson Chi Square Test

Regurgitation	GERD	NO GERD	Total
Present	2	2	4
Absent	0	60	60
Total	2	62	64

p value = 0.000

CHART 3

BREATHLESSNESS IN CHRONIC COUGH



Out of 17 cases with history of triggers for cough, breathlessness and wheeze, 14(82.35%) cases were diagnosed finally as asthma and 3(17.65%) cases as pneumonia. The difference observed was found to be statistically significant (p value 0.000).

Table 11

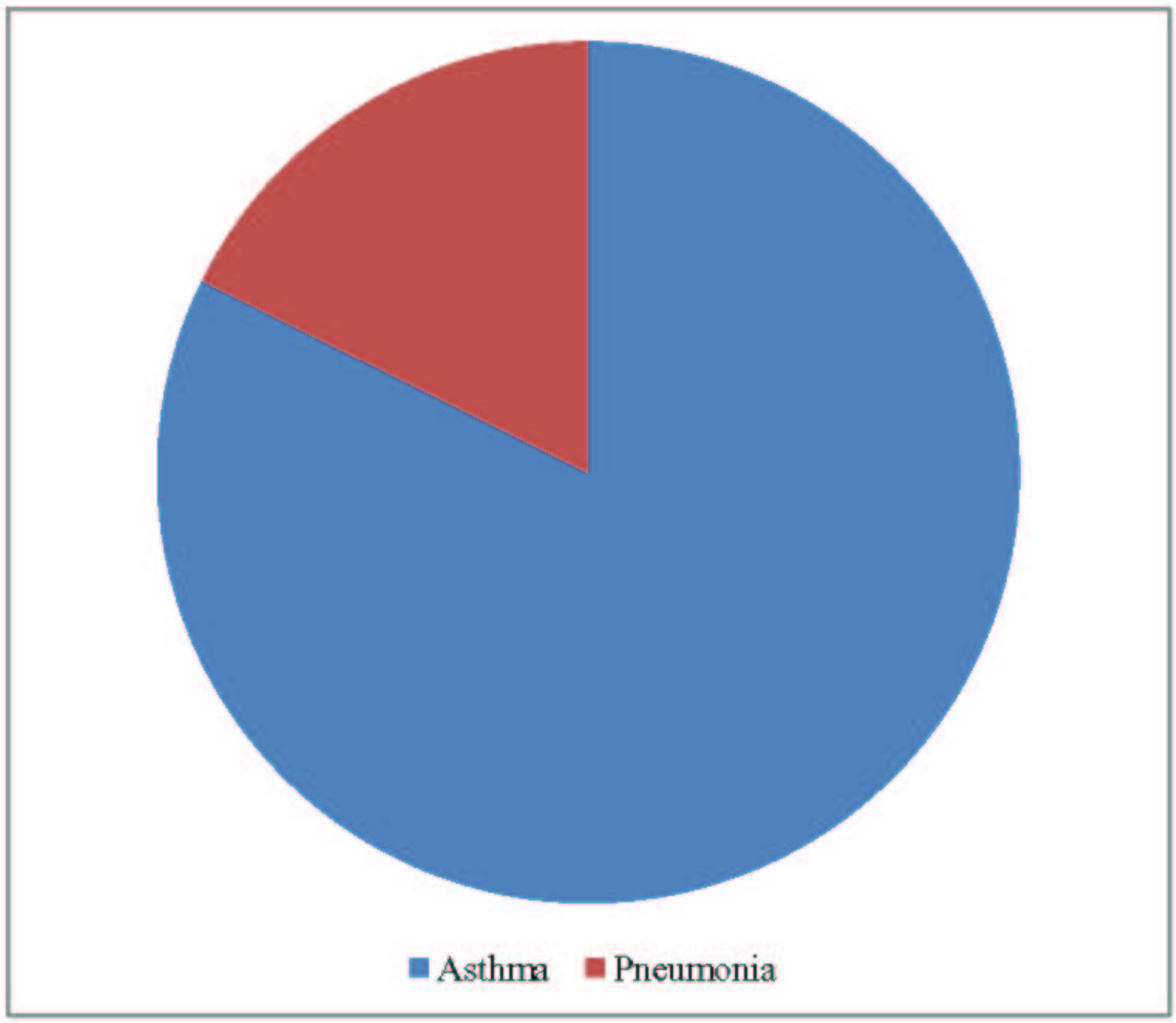
Pearson Chi Square Test

Triggers	Asthma	No asthma	Total
Present	14	3	17
Absent	0	47	47
Total	14	50	64

p value = 0.000

CHART 4

TRIGGERS AND DIAGNOSIS



ATOPY AND CHRONIC COUGH

Family history of atopy was noted in 10 (15.62%) cases of chronic cough, of them 6 (60%) were in asthma group, 3 (30%) in pneumonia group and 1(10%) in sinusitis group. Atopy was more commonly observed among asthma cases when compared to other conditions and the difference was found to be statistically significant. (p value 0.000).

Table 11

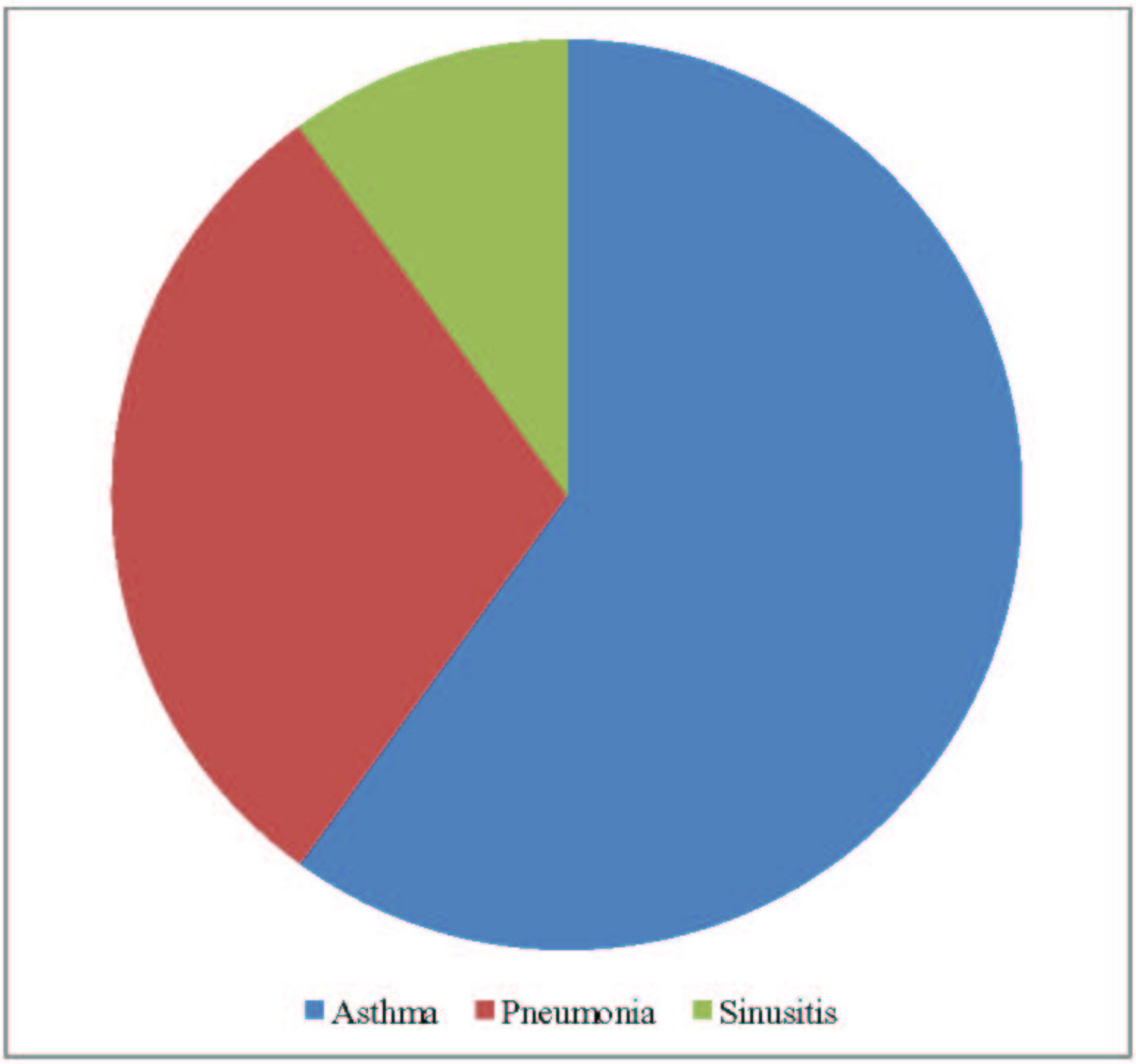
Pearson Chi Square Test

Atopy	Asthma	No asthma	Total
Present	7	3	10
Absent	6	48	54
Total	13	51	64

p value = 0.000

CHART 5

ATOPY



FAMILY HISTORY OF ASTHMA IN CHRONIC COUGH

The number of children with family history of asthma was 8(12.5%) cases of chronic cough. 4 cases were in asthma group, 1 case in TB group, 1 in bronchiectasis group, and 1in pneumonia group. This difference in the family history of asthma was found to be statistically significant (p value 0.040).

Table 12

Pearson Chi Square Test

Family History of Asthma	Asthma	No Asthma	Total
Present	4	4	8
Absent	10	46	56
Total	14	50	64

p value = 0.040.

PAST HISTORY

Past history of wheeze with response to bronchodilators was found in17 (26.56%) patients of chronic cough. Out of the 17 patients,

the final diagnosis was asthma in 14 patients and pneumonia in 3 patients. Past history of wheeze is found in more number of patients with asthma than other conditions. The difference observed is found to be statistically significant (p value 0.000).

Table 13

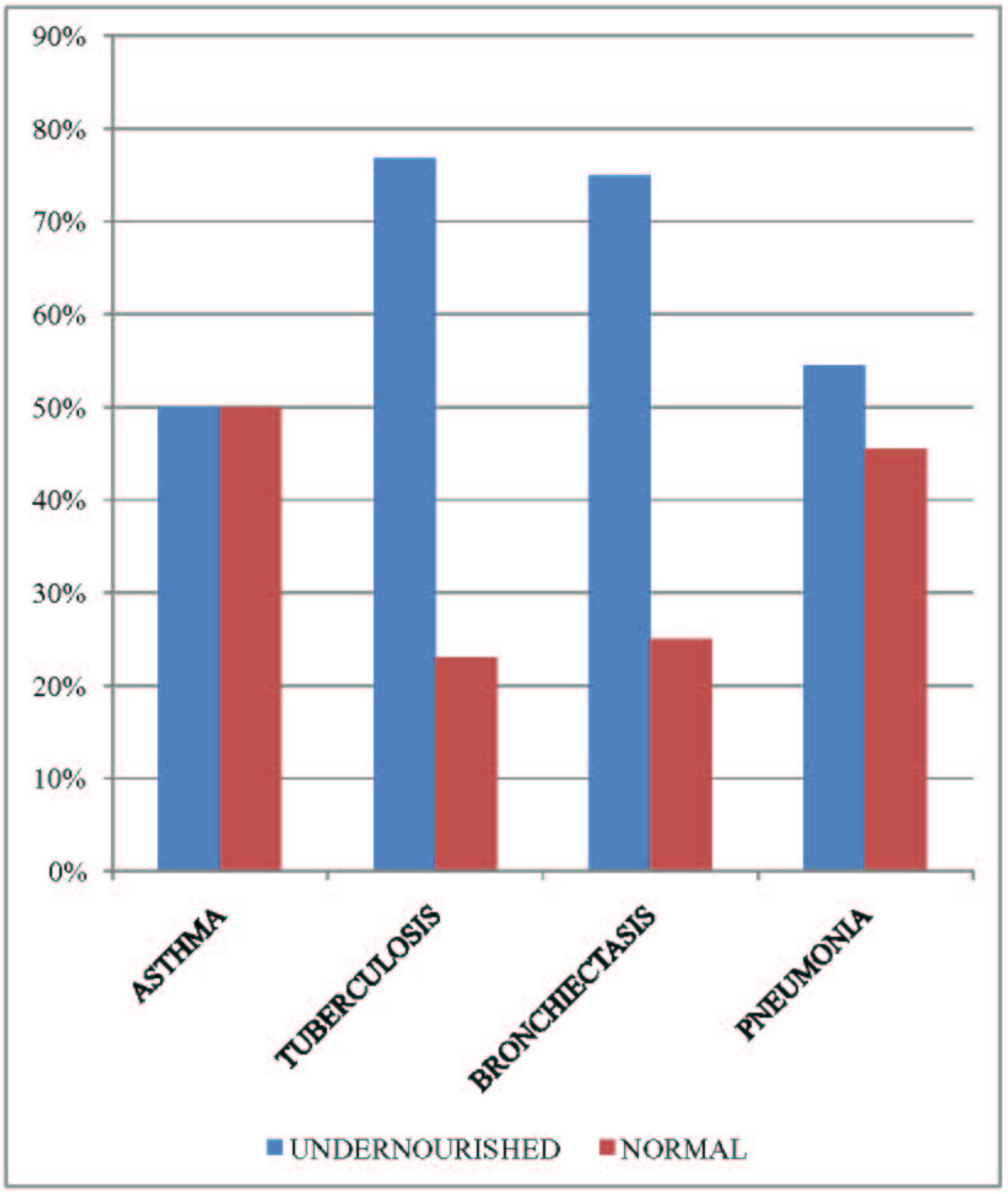
Undernourished Chidren in chronic cough

Diagnosis	Undernourished Children n (%)
Tuberculosis	10 (76.9%)
Bronchiectasis	6 (75%)
Pneumonia	6 (54.5%)
Asthma	7 (50%)

Under nutrition was found in 76.9% of TB cases, 75% of bronchiectatic children, 54.5% of pneumonia cases and 50% of asthma cases. Under nutrition was more prevalent among the TB cases when compared to others, but the difference was found to be statistically insignificant (p value 0.118).

CHART 6

UNDERNOURISHED CHILDREN IN CHRONIC COUGH



CONTACT HISTORY OF TB AND CHRONIC COUGH

Contact history of Tuberculosis was found in 8(66.6%) tuberculosis cases and 1 bronchiectasis case and 1 pneumonia case. Contact history of tuberculosis is found to be a significant risk factor for diagnosing tuberculosis (p value 0.000).

Table 14

Pearson Chi Square Test

Contact History Of Tb	TB Cases	Non TB Cases	Total
Positive	8	2	10
Negative	5	49	54
Total	13	51	64

P Value = 0.000

TB- tuberculosis

CLUBBING

Clubbing was noted in 6(9.3%) cases of chronic cough, of which 1 case was diagnosed as interstitial lung disease and the other 5 as

bronchiectasis. Clubbing was more common in bronchiectasis case than other cases. This difference is found to be statistically significant (p value 0.000).

CERVICAL LYMPHADENOPATHY AND CHRONIC COUGH

Cervical lymphadenopathy was noted in 20 (31.25%) cases of chronic cough. Of them, 10 cases were diagnosed as TB, 6 were diagnosed as bronchiectasis, 4 diagnosed as pneumonia. Cervical lymphadenopathy was found to be associated more with TB cases than other conditions. The difference observed was found to be statistically significant (p value 0.001).

Table 15

Pearson Chi Square Test

Cervical Lymphadenopathy	Tuberculosis	No Tuberculosis	Total
Present	10	10	20
Absent	1	43	44
Total	11	53	64

p value = 0.001

MANTOUX TEST

Mantoux test was done in 58 (90.64%) cases of chronic cough patients where tuberculosis was suspected. Out of them, 12 (19%) were positive and 47 (81%) were negative. Of the Mantoux positive cases, 9(75%) were in tuberculosis group, 2(16.6%) in pneumonia group and 1(8.3%) in asthma group. Mantoux positivity was found to be more among the TB cases when compared to other conditions. The difference observed was found to be statistically significant (p value 0.000).

Table 16

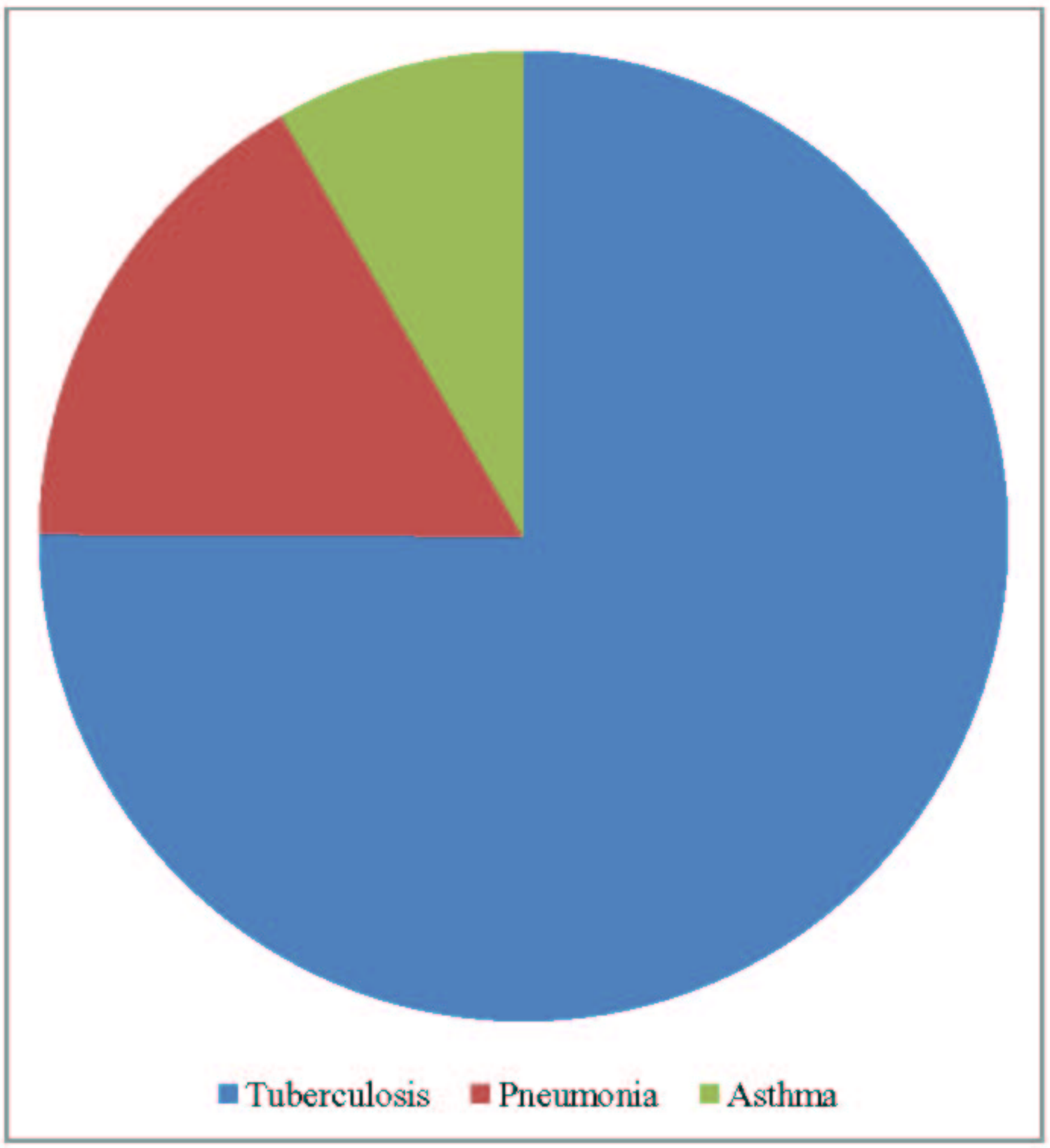
Pearson Chi Square Test

Mantoux	TB Cases	Non Tb Cases	Total
Positive	9	2	11
Negative	4	49	53
Total	13	51	64

p value = 0.000

CHART 7

MANTOUX POSITIVITY



OTHER INVESTIGATIONS

Counts

Total leukocyte count was normal in 40 (62.5%) cases, increased in 23(35.93%) cases of chronic cough. 1 (1.56%) case showed an absolute eosinophil count of 4600, which was diagnosed as eosinophilic pneumonia.

Sputum for Acid fast bacillus (AFB)

Sputum/Resting gastric juice for AFB was done in 46 patients and all were negative for AFB.

Radiography

X ray chest was done in all the patients. Radiograph chest was normal in13 (20.3%) patients with chronic cough. In 2 children with suspected sinusitis, X ray paranasal sinuses was taken, which revealed sinusitis. 23 cases of chronic cough had consolidation in the X ray, but the final diagnosis of pneumonia was made in 11 cases only. This is due to the fact that many cases of tuberculosis and bronchiectasis had X ray feature suggestive of consolidation. Out of the 8 cases of bronchiectasis, x ray reported as bronchiectasis in 4 cases, bronchiectasis with

consolidation in 3 cases and in the other case, the report was consolidation only. A case of miliary tuberculosis was diagnosed by x ray chest.

X-ray normal	X-ray abnormal
13 cases	41 cases

Table 16

X Ray features in chronic cough

Findings	Number	Percentage (%)
Pneumonia	23	35.9
Normal	13	20.3
Bilateral Hyperinflation	10	15.6
Bronchiectasis	7	10.9
Collapse	3	4.7
Emphysema	3	4.7
Eosinophilic Lung	1	1.6
Miliary Tb	1	1.6
Pansinusitis	1	1.6
Pneumatocele	1	1.6
Sinusitis	1	1.6
Total	64	100%

BARIUM SWALLOW

Barium swallow was done in 4 chronic cough cases with suspected gastro-esophageal reflux. Gastro esophageal reflux disease was diagnosed in 2 cases and barium swallow was normal in other 2, a case of pneumonia and a case of laryngomalacia. Barium swallow was found to be positive in GERD cases than in other condition. This difference observed was found to be statistically significant (p=0.000)

HIV ELISA TEST

HIV ELISA was done in 12 chronic cough cases with suspected immunodeficiency. In all the cases, the test was non reactive.

BRONCHOSCOPY

Bronchoscopy was required in 28 patients of chronic cough. Bronchoscopy was normal in 7 cases. In remaining cases, specific diagnoses were made. Flexible bronchoscopy was used for diagnostic purposes and rigid bronchoscopy for foreign body retrieval. Foreign body was removed in 3 cases using rigid bronchoscopy, 1 case required thoracotomy for foreign body removal. The foreign body removed in 3 cases was groundnut and a red button in the other case.

Table 17

Bronchoscopy in chronic cough

Findings	Number	Percentage (%)
Granulation tissue	10	37%
Normal	7	25.9%
Tracheomalacia	3	11.1%
Foreign body	3	11.1%
Laryngomalacia	2	7.4%
Extrabronchial compression	1	3.7%
Mucopurulent secretions	1	3.7%
Multiple masses just above glottis	1	3.7%

BRONCHO-ALVEOLAR LAVAGE

Broncho-alveolar lavage was done for 3 cases of the chronic cough with suspected endobronchial tuberculosis and for a case of eosinophilic pneumonia. Three were negative for acid fast bacilli. In case of eosinophilic pneumonia, eosinophil count was found to be 45%, neutrophils 10%, lymphocytes 5%, monocytes 40% in bronchoalveolar lavage.

COMPUTED TOMOGRAPHY SCAN

CT scan chest was done in 18 cases out of 64 chronic cough cases. CT scan was used for the confirmation of bronchiectasis. Diagnosis of interstitial lung disease, paraganglioma, bronchiolitis obliterans was confirmed by CT scan

Table 18

CT-Chest Findings in Chronic Cough

Findings	Number	Percent (%)
Bronchiectasis	8	14.1%
Normal	2	3.1%
Collapse	1	1.6%
Bronchiolitis Obliterans Organising Pneumonia	1	1.6%
Consolidation	1	1.6%
Interstitial Lung Disease	1	1.6%
Paraganglioma	1	1.6%
Pneumonia	1	1.6%
Emphysema	1	1.6%
Collapse	1	1.6%
Not Done	46	71.9%
Total	64	100%

DISCUSSION

Chronic cough (cough of 4 weeks or more) in children poses anxiety to the parents and the treating physicians. The use of unnecessary medications will result in adverse effects than cure and hence specific cause of chronic cough is to be made out. Our study is aimed at finding out the causes of chronic cough in children aged 1 to12 years.

Children who presented with chronic cough (cough of 4 weeks or more) in the Outpatient department of Institute of Child Health and Hospital for Children were taken in to study.

Total of 64 cases were recruited.

COUGH CHARACTERISTICS

Age

Majority of children [24(37.5%)] who presented with chronic cough were in 4 to 6 years age group. The mean and standard deviation of the age of presentation was 5.35 ± 3.07 years.

Sex

The proportion of boys (67.2%) was more than girls (32.8%) in children who presented with chronic cough. Boys outnumbered girls in all the age groups.

Duration of cough

Duration of cough in study population varied from 1 month to 5 months. The mean and standard deviation of cough duration were 63.75 ± 41.91days. The range of cough was between 1 month to 5 months.

Type of cough

No specific type of cough was noted in cases of chronic cough.

Expectoration

All the cases of chronic cough with sputum production had the final diagnosis as bronchiectasis.

Diurnal variation

The cough occurred most frequently during the day than at night. Day time cough frequency was documented in 50(78.5%) and night time cough in 14(21.5%). There was no significant correlation noted between

the timing of cough and the diagnosis. This is comparable to the study of Dani *et al,* in which the cough has occurred frequently during daytime in 61(57.4%) cases as opposed to night time cough in 33 (39.3%) cases[20].

Seasonal variation

Seasonal variation of cough was noted in 6 (9.37%) cases of chronic cough. Remaining was non- seasonal 58 (90.63%). Percentage of non- seasonal cough in the study of Dani was 58(62.7%) [20]. All the cases with seasonal variation had the final diagnosis as asthma in our study.

Breathlessness

Number of cases of chronic cough that presented with breathlessness was 47(73.4%) when compared to the study of Dani, *et al* where it was 59(62.7%) cases[20].

Fever

53(82.8%) cases of chronic cough had an associated symptom of fever. This is more when comparing to the study of Dani *et al*, where fever was an associated symptom in 44(45.7%) cases. There was a

significant association between fever and pneumonia in our study (p value 0.001).

Regurgitation

Regurgitation was noted in 4 (6.25%) of the cases of chronic cough. Regurgitation is a significant history for diagnosis of gastro oesphageal reflux disease (p value 0.000).

Triggers

History of triggers for symptoms like cough, wheeze and breathlessness was noted in 17(26.56%) of the cases. All the cases of asthma had a positive history of triggers. Occurrence of triggers in asthma cases is more compared to other cases (p value 0.000).

Contact history of tuberculosis

Contact history of tuberculosis was present in 10(15.65%) cases of chronic cough. This is comparable to the study of Dani where the contact history of tuberculosis was noted in13 (13.8%) cases of chronic cough. Contact history of Tuberculosis was found in 8(66.6%) tuberculosis cases which is also comparable to the study of Dani where it is 60% of tuberculosis patients[20]. Contact history of tuberculosis was

found to be a significant factor for the diagnosis of TB (p value 0.000) in our study.

Past history

Past history of treatment with anti tuberculosis drug was present in 3 (4.68%) of the chronic cough cases. Previous history of wheeze and relief with bronchodilators was documented in 17 (26.56%) cases with chronic cough.

Family history

Family history of asthma was present in 8 (12.5%) cases compared to 15(16%) cases in the study of Dani and his colleagues[20]. But the p value of this correlate in our study was insignificant (p value 0.04).

Family history of atopy was noted in 10(15.6%) chronic cough cases compared to 11(11.7%) cases in the study of Dani *et al*[20]. The presence of atopy in cases of asthma was more when compared to other cases and this difference if found to be significant (p value 0.001) in our study.

Smoking

The influence of environmental influences, especially tobacco smoke, on cough and other respiratory symptoms and frequency of respiratory infections is undoubtedly significant[(32)]. Thus, in the management of any child with cough, irrespective of the etiology, attention to exacerbating factors, especially environmental tobacco smoke, is encouraged. History of passive smoking was present in 7 (10.93%) chronic cough cases, comparable to the case control study of Daljit which had a family history of smoking as16.7% of cases in contrast to 6.4% in controls ($p = 0.05$)[21]. But was less when compared to the study of Dani[20], where it was 22(23.4%) cases of chronic cough.

Overcrowding

Overcrowding was noted in 6 (9.5%) cases but there was no correlation of it to any of the diagnosis obtained in our study.

Immunization

It was found that only 86.9% was fully immunized as per National Immunization Schedule and the remaining not. None of the cases were given Pneumococcal or Hemophilus influenza B vaccine.

Weight

Number of undernourished children in our study was 37 (57.8%) out of 64 cases of chronic cough. The proportion of undernourished children were found to be more in tuberculosis group [n=10(27%)] followed by asthma cases [n=7(18%)]. All the other diagnosis constitutes the rest.

Clubbing

Clubbing was seen in 6(9.3%) cases of chronic cough compared to 5(5.3%) cases in the study of Dani[20.]

Lymphadenopathy

Cervical lymphadenopathy was noted in 20 (31.25%) cases. The number of cases with cervical lymphadenopathy in Dani's was 25(26.5%) out of 94 chronic cough cases.

Chest examination

On chest examination, rhonchi was noted in 22(34.34%) cases of chronic cough. This is less when compared to the study of Dani where the frequency of rhonchi was 57(60%) cases out of 94 cases of chronic cough.

Crepitations were documented in 52(81.25%) cases of chronic cough. This is more than that found in the study of Dani, 48 cases(51%).

Diagnosis

The causes of chronic cough were found to be bronchial asthma in 21.9%(n=14), tuberculosis in 20.3%(n=13), bronchiectasis in 12.5%(n=8), pneumonia in 17.2%(n=11) and the other diagnoses constitute the rest.

The most common diagnosis in this study was found to be bronchial asthma in 21.9% cases of chronic cough. This is comparable to the study made by Suna Asilsoy, *et al* where 25% of the cases were diagnosed to have asthma and asthma like condition[19]. Dani *et al* in their study had found bronchial asthma in 23.4% and cough variant asthma 13.8%[20]. Daljit singh *et al* in their prospective case control study found that the most common cause was bronchial asthma (66.7%)[21]. Shally Awasthi *et al* in a prospective study based on questionnaire method found the prevalence of asthma and wheeze to be 2.3% and 6.2%[22]. Types of asthma found were mild persistent asthma in 12 and moderate persistent asthma in 2 of the cases (total n=14).

Among the asthma cases, history of atopy was present in 71% of cases and triggers were positive in 100% with a significant p value. Family history of asthma was found in 28.5% of cases, atopy in 7% of cases. Dani *et al* in their study have found family history of asthma to be positive in 41% of cases[20]. Daljit singh *et al* in their study found the family history of allergy/asthma was noted in 11 (45.8%) children as compared to 52 (10.4%) in the control group ($p < 0.01$)[21].

Overcrowding and pets were not contributory to any of the diagnosis in our study.

Pneumonia is diagnosed in 17.2%(11) cases. Persistent pneumonia was diagnosed in 2 cases and recurrent pneumonia in 2 cases. One case of recurrent pneumonia was found to have gastro esophageal reflux disease, and the other case had laryngomalacia. One case of persistent pneumonia had asthma as predisposing factor. Rakesh Lodha, *et al* in their study of causes of persistent pneumonia found out asthma and post-tubercular bronchiectasis as the important causes of persistent pneumonia[23]. Eosinophilic pneumonia was diagnosed in one of the cases, with X ray diagnosed as eosinophilic lung. The child had an increased absolute eosinophil count of 4600 and

bronchoalveolar lavage showed an increase in the eosinophil count (E45,N10, L5 and M40) .

Tuberculosis was diagnosed in 13(20.3%) cases. This is a comparable number to the study done by Dani *et al* where it was 21(22.3%) of cases[20]. Mantoux positivity was observed in 12.7% of cases with tuberculosis than in other cases of chronic cough. This difference is found to be statistically significant. More than 75% of children diagnosed as tuberculosis were undernourished.

Bronchiectasis was diagnosed in 8(12.5%) cases. The percentage of these cases in the study of Dani *et al* was found to be 5(5.3%) [20]. Cases that presented with excessive sputum production were 4(50%). X ray chest was diagnostic in 7 of the cases of bronchiectasis. High resolution computed tomography scan remains the gold standard for the diagnosis of bronchiectasis. All the cases of bronchiectasis in our study had CT evidence of bronchiectasis.

Foreign body was diagnosed in 4 (6.3%) cases of chronic cough. Dani *et al* diagnosed foreign body in 2 (2.2%) cases. Radiography was diagnostic in 50% of the cases. Flexible bronchoscopy was diagnostic in

all the cases. Rigid bronchoscopy was therapeutic in retrieval of foreign body in 3 cases.

Airway anomaly was diagnosed in 3(4.8%) cases. Two of the cases were tracheomalacia and one case was laryngomalacia. Careful history and physical examination is useful in arriving at the diagnosis. Bronchoscopy was used for the confirmation of the diagnosis. All the cases were of 1 to 3 years age group.

Gastro esophageal reflux was diagnosed in 2 (3.2%) cases which is comparable to the study of Dani *et al*, 2 (2.2%) cases[20], and the study by Suna Asilsoy in which, 4.6% of cases were diagnosed to have GERD[19].

Erosive gastritis was diagnosed in 1 (1.6%) case of chronic cough. These cases presented with blood vomiting, cough and recurrent vomiting. Endoscopy revealed gastro esophageal reflux and erosions of the gastric mucosa.

Sinusitis was diagnosed in 1(1.6%) case. In evaluation of chronic cough by Dani *et al* from Nagpur, sinusitis was diagnosed in 9 (9.5%) patients[20]. Paramesh from Bangalore diagnosed sinusitis in 10% of chronic cough cases and Nadkarni and Lahiri from Lucknow diagnosed

it in 16% of cases[20]. This difference would have been due to the fact that many of the cases of sinusitis they consult in the ENT department in our hospital. The patients presented with cough, headache and a sensation of clearing the throat frequently. Sinus tenderness was noted. Radiology of sinuses and CT scan of sinuses were needed for the diagnosis. There may be asymmetry of sinuses and the sinuses are opacified in CT paranasal sinuses.

Interstitial lung disease was diagnosed in 1(1.6%) case. Child presented with breathlessness and cough of more than one month. Radiography showed bilateral hyperinflation. CT scan chest revealed the diagnosis of interstitial lung disease. Interstitial lung disease was not a diagnosis in any of the studies of chronic cough.

Laryngeal papilloma was diagnosed in 1(1.6%) case. This was an accidental diagnosis made in a child who presented with cough for 3 months, voice change of 2 weeks, stridor, and breathlessness for 5 days and throat tenderness. Radiography of neck and soft tissue was normal. Direct microlaryngoscopy under general anaesthesia, revealed multiple masses just above the glottis. Biopsy showed papillomatous change, microlaryngeal excision was done. It is a rare viral disease where a number of non-cancerous growths form in the respiratory tract.

Paraganglioma- left bronchus was diagnosed in 1(1.6%) case. This diagnosis was never thought of when the child presented to the outpatient department with cough of 2 months duration, breathlessness on and off. On examination, air entry was diminished on left side of thorax. Radiography showed atelectasis left lobe of lung. HRCT showed enhancing hypodense intraluminal lesion extending up to subcarinal region causing complete obstruction of left lower lobar and partial obstruction of left upper lobar bronchi with distal atelectasis of left lower lobe and lingular segments of left upper lobe - paraganglioma. Pneumonectomy left lung was done. Paraganglioma is said to cause recurrent pneumonia.[32]

Bronchiolitis obliterans was diagnosed in 1.6%(n=1) cases. The child presented with cough of 5 months duration, breathlessness, and fever of 10 days duration. Radiography revealed nodular opacities both lower lobes with atelectasis. HRCT showed bronchiectatic changes both lower lobes with tractional atelectasis with air trapping – Bronchiolitis Obliterans Organising Pneumonia (BOOP). Lung biopsy reported as diffuse fibrosis of alveolar septa, dense inflammatory cell infiltration, distorted terminal air spaces suggestive of bronchiolitis obliterans organizing pneumonia (BOOP)

BOOP is often caused by a pre-existing chronic inflammatory disease like rheumatoid arthritis. BOOP can also be a side effect of certain medicinal drugs, e.g. amiodarone. It is also known as cryptogenic organizing pneumonia (COP) Reported incidence is 0.01%, but COP may be more common and under diagnosed[33, 34, 35]. The diagnosis needs to be confirmed by CT chest.

Hypoplasia right lung was the diagnosis in 1(1.6%) cases. This was an accidental diagnosis made in a child who presented with cough of 2 months duration, breathlessness on and off since birth. Air entry diminished on right side with bronchial breath sounds. X ray showed consolidation right lung with collapse. Bronchoscopy picked up mucopurulent secretions only. High resolution CT showed hypoplastic right lung. The overall prevalence[(34)] from autopsy findings (US based study) is 1.1 per 1000 live births and 9.8 per 1000 referrals[36].

1(1.6%) case was undiagnosed. Child presented with cough of 3 months duration. All the investigations were found to be normal.

SUMMARY

1. In this study, total of 64 children with chronic cough were recruited.

2. The mean and standard deviation for the duration of chronic cough was 63.75 ± 41.91days. The range of cough was from 1 month to 5 months.

3. Most of the children with chronic cough [44(68.75% of the total)] belonged to < 6 years age group. The mean age of presentation was 5.35 ± 3.07.

4. In all the age group strata, boys outnumbered girls.

5. Breathlessness was associated with 74.6% of cases. It was found that >90% of tuberculosis cases presented with breathlessness at the time of presentation.

6. Fever was the presenting symptom in 55.6% of cases and it was found mostly in pneumonia cases as compared to other diagnosis (p value of this difference was 0.001).

7. Cases of chronic cough that presented with sputum production were 4 and all the 4 cases were found to be bronchiectasis.

8. Regurgitation is a significant history for diagnosis of gastro oesphageal reflux disease.

9. History of triggers for the symptoms of cough, wheeze and breathlessness is found to have a significant correlation with asthma (p value 0.000).

10. Family history of atopy and asthma were found in significant number of children with asthma than in any other diagnosis. This difference is found to be statistically significant.

11. Asthma was the most common cause of chronic cough and it was diagnosed in (n=14) 21.9% of cases. 12 cases were mild persistent in severity and 2 were moderate persistent. Most cases of asthma just required a detailed history and clinical examination for arriving at the diagnosis. Tuberculosis was diagnosed in 13 (20.3%) cases, Pneumonia in 11(17.2%) cases, and Bronchiectasis was diagnosed in 8(12.5%) cases.

12. Total number of undernourished children in our study was 37(58.7%). Out of them, the maximum number of cases was in tuberculosis group (76.9%).

13. Contact history of TB and the diagnosis of TB were found to have significant association in our study

14. Bronchoscopy was required in 28 cases. In 21 cases, bronchoscopy was diagnostic.

15. CT scan was performed in 19 of the cases. CT was diagnostic in 17 cases.

16. Barium swallow was diagnostic in all the cases of gastro oesophageal reflux.

17. In 7.6% of cases, two diagnoses existed for the same case. Asthma was associated with pneumonia, mucous plug obstruction and collapse lung. Recurrent pneumonia was associated with airway anomaly, gastro esophageal reflux disease.

CONCLUSION

Chronic cough is more common in children less than 6 years of age (68.75%) in our study.

Etiological diagnosis of chronic cough was arrived in 98% of the study population emphasizing the role of a structured protocol with detailed history, thorough clinical examination and appropriate investigations.

The major causes of chronic cough in children in our study were asthma, tuberculosis, pneumonia and bronchiectasis.

Rare causes of chronic cough (hypoplasia lung, interstitial lung disease, paraganglioma and laryngeal papilloma) identified in our study emphasize the role of special investigations like CTand bronchoscopy to complete the investigatory work up.

A child presenting with chronic cough cannot be left undiagnosed as the rare underlying cause may prove to be fatal if not investigated in proper time.

BIBLIOGRAPHY

1. Leonardi GS, Houthuijs D, Nikiforov B. Respiratory symptoms; bronchitis and asthma in children of Central and Eastern Europ. Eur Respir J. 2002; 20: 890-898.

2. Leonardi GS, Houthuijs D, Nikiforov B. Over-the-counter medication use among US preschool age children. JAMA 1994; 272: 1025-1030.

3. Black P. Evaluation of chronic or recurrent cough. In: Pediatric Respiratory disease: Diagnosis and Treatment. Editors Hilman BC, Philadelphia, W.B. Saunders Company, 1993; pp143-153.

4. Britt H, Miller GC, Knox S. General practice activity in Australia 2003–04. Canberra: Australian Institute of Health and Welfare, 2004. (AIHW Cat. No. GEP 16.)

5. Cornford CS, Morgan M, Ridsdale L. Why do mothers consult when their children cough? Fam Pract 1993; 10: 193-196.

6. Thomson F, Masters IB, Chang AB. Persistent cough in children - overuse of medications. J Paediatr Child Health 2002;38:578-581.

7. Anna B Chang, Lou l Landau. Cough in children;definitions and clinical evaluation, Medical Journal of Australia 2006;184;398-403.

8. Irwin RS, Boulet LP, Cloutier MM, Fuller R, Gold PM, Hoffstein V. Managing cough as a defense mechanism and as a symptom. Chest 1998; 114:S133-181.

9. Widdicombe JG. Afferent receptors in the airways and cough. Resp Physiol 1998; 114:5-15.

10. O'Brodovich HM, Haddad GG. The functional basis of respiratory pathology and disease. In: Chernick V, Boat TF, Fletcher J, eds. Kendig's Disorders of the Respiratory Tract in Children. 6th ed. Philadelphia: WB Saunders, 1998;pp 27-73.

11. Karlsson JA. The role of capsaicin-sensitive C-fibre afferent nerves in the cough reflex. Pulm Pharmacol 1996; 9:315-321.

12. Lee YL, Pisarri TE. Afferent properties and reflex functions of bronchopulmonary C-fibers. Resp Physiol 2001; 125:47-65.

13. Bolser DC, Davenport PW. Expiratory motor control during the cough reflex. Eur Resp Rev 2002; 12:85,243-248.

14. Sant'Ambrogio G, Widdicombe J. Reflexes from airway rapidly adapting receptors. Resp Physiol 2001; 125:33-45.

15. Canning BJ. Interactions between vagal afferent nerve subtypes mediating cough. Pulm Pharmacol Ther 2002; 15:187-192.

16. 16.. Mazzone SB, Canning BJ. Plasticity of the cough reflex. Eur RespRev 2002; 12:85,236-242.

17. Chang AB, Glomb WB. Guidelines for evaluating chronic cough in pediatrics: ACCP Evidence-Based Clinical Practice Guidelines. Chest 2006; 129: 260S-283S.

18. Chang AB. Causes, assessment and measurement in children. In: Chung KF, Widdicombe JG, Boushey HA, editors. Cough: causes, mechanisms and therapy. London: Blackwell Science, 2003:pp 57-73.

19. Suna Asilsoy, Erhan Bayram. Evaluation of Chronic cough in children. CHEST 2008;DOI 10.1378/CHEST.08-0885.

20. V.S. Dani. Evaluation of chronic cough in children: Clinical and Diagnostic spectrum and outcome of specific therapy; Indian Pediatrics 2002; 39; 63-69.

21. Daljit Singh. Chronic /Recurrent cough in Rural children in Ludhiana, Punjab. Indian Pediatrics 2002; 39: 23-29.

22. Shally Awasthi. Prevalence and risk factors of asthma and wheeze in school going children in Lucknow, North India. Indian Pediatrics 2004;41:1205-1210.

23. Rakesh Lodha, Persistent Prevalence in Children. Indian Pediatrics 2008;40:967-970.

24. Thompson. Persistent cough in children and the overuse of medications. J Paediatr Child Health 2002; 38(6);578-581.

25. H M Lewis *et al*. Chronic cough in hospital population; its relation to atopy and defect in host defence._Arch Dis Child. 1989; 64(11): 1593–1598

26. A O Faniran Persistent cough: is it asthma? Arch Dis Child 1998;79:411-414.

27. T K Ninan. Persistent nocturnal cough in childhood. Arch Dis Child.1995;73(5):403-407

28. Hollinger LD, Sanders AD. Chronic cough in infants and children: An update: Laryngoscope 1991;101: 596-605.

29. Irwin RS, French CL, Curley FJ. Chronic cough: The spectrum and frequency of causes, key components of the diagnostic evaluation and outcome of special therapy. Am Rev Respir Dis 1990; 141: 640-647.

30. Irwin RW, Corrao WM, Pratter MR. Chronic persistent cough in the adult: The spectrum and frequency of causes and successful outcome of specific therapy: Am Rev Respir Dis 1981; 123: 413-417.

31. Irwin RS. Widdicombe J. Cough. In: Textbook of Respiratory Medicine, 2nd edn. Eds. Murray JF, Nadel JA. Philadelphia, W.B. Saunders Co, 1994; pp 529-554.

32. Kee Ai-Rene. Paraganglioma: The American Journal of Surgical Pathology 2003; 27: 1380-1385.

33. Bronchiolitis obliterans organising pneumonia: Dorlands Medical Dictionary.

34. Alasaly K, Muller N, Ostrow DN, Champion P, FitzGerald JM (July 1995). “Cryptogenic organizing pneumonia” Medicine (Baltimore).

35. Geddes DM .”BOOP and COP”. Thorax 1991; 46 (8): 545–547.

36. Adrein C. Moessinger, Angelita Santiago. Pediatric and Perinatal epidemiology, 2000;3:421-431.

ANNEXURE

PROFORMA

EVALUATION OF CHRONIC COUGH IN CHILDREN

AGED 1 TO 12 YEARS

REGISTRATION NUMBER

NAME

AGE

SEX

ADDRESS

HOSPITAL NUMBER

DATE OF ADMISSION AND DISCHARGE

PRESENTING COMPLAINTS

COUGH

- Duration
- Type
- Diurnal variation

- Seasonal variation
- Stridor
- Post tussive vomit
- Hemoptysis
- Casts

BREATHLESSNESS

- DURATION
- SEASONAL VARIATION
- EXERTIONAL

FEVER

- Duration

NASAL DISCHARGE

POST NASAL DRIP

LOSS OF WEIGHT AND APPETITE

REGURGITATION OF FEEDS

ECZEMA

EAR DISCHARGE

WORM INFESTATION

PAST HISTORY

- Anti tuberculosis drugs
- Wheezing and relief with bronchodilators

FAMILY HISTORY

- Tuberculosis
- Asthma
- Atopy
- Smoking

ENVIRONMENTAL HISTORY

- Overcrowding

CLINICAL EXAMINATION

- General examination
- Upper airway examination
- Lower airway examination
- Respiratory system examination
- Other systems examination

INVESTIGATIONS

BLOOD COUNTS

MANTOUX

SPUTUM/ RGJ FOR AFB (3 SAMPLES)

X RAY CHEST

BARIUM SWALLOW STUDY

X RAY PARANASAL SINUSES

HIV ELISA

BRONCHOSCOPY

CT CHEST/ PARANASAL SINUSES

TISSUE BIOPSY